HLA FOM/SOM Content Standards

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ABSTRACT

Compared to fixed Protocol Data Unit (PDU) structures, interfaces between simulation elements are more flexible in the recently introduced High Level Architecture (HLA). However, this increased flexibility also creates the opportunity for miscommunication and mismatch when the same concepts are described in Federation Object Models (FOMs) and Simulation Object Models (SOMs) using different structures and terminology. Judicious application of data standards to FOM/SOM content will greatly reduce potential confusion and improve interoperability.

This paper describes the efforts to establish data standards for use in FOM/SOM content. Standards will be derived from external authoritative sources when possible and from the simulation community when appropriate. Results will be captured in an HLA Data Dictionary (HLA-DD) providing common semantics and syntax for FOM and SOM content. The HLA-DD will be integrated with Object Model Development Tools (OMDTs) as well as the HLA Object Model Library (OML). Resulting tools, content standards, and procedures will allow developers to rapidly create understandable, unambiguous, and reusable FOMs and SOMs.

BACKGROUND

The HLA allows much greater flexibility in structuring interfaces between simulation federates than was available with IEEE 1278.1 protocols. The IEEE 1278.1 protocols rigidly established interfaces between simulations through a finite set of PDU structures with enumerated sets of values for many PDU fields.

The HLA provides the flexibility to customize the interfaces among simulation federates through the statement of FOMs and to specify the interface capabilities of individual federates in SOMs. By specifying an Object Model Template (OMT) and the associated Federation Execution Data (FED), the federate or federation developer can define classes of objects as well as their public attributes and interactions. The OMT can also define enumerations of attributes and interaction parameters.

With this increase in flexibility, however, there is a potential for confusion and the loss of reusability. Each federate or federation developer has the freedom to choose new names for classes, attributes, interactions, and interaction parameters as well as define new sets of enumerations, even when describing the same concepts. The potential exists for an explosion of synonyms, making it difficult for federate and federation developers to determine when similar concepts are being expressed.

FOM/SOM CONTENT STANDARDS

The solution to these problems is to apply sound data engineering principles to the construction of FOMs and SOMs. The Defense Modeling and Simulation Office (DMSO) has initiated such an effort as part of the Data Standards component of the Modeling and Simulation Common Technical Framework (M&S CTF). The M&S CTF is called for in the DoD M&S Master Plan. The goal of the HLA FOM/SOM Content Standards Program is to establish a constrained lexicon of terms for inclusion in FOMs and SOMs and thereby avoid an explosion of synonyms. Achieving this goal will increase the recognition, realization, repeatability, and reuse aspects of the FOM/SOM development process.

Recognition

The first goal of the FOM/SOM Content Standards Program is to allow the federate or federation developer to easily recognize concepts and terms used in existing FOMs and SOMs. This will be done by using standard terminology from the area of interest being simulated in a federate or federation. Terms will be drawn from authoritative sources. A second component of recognition will be the establishment of naming standards. A set of guidelines will be established for the creation of new class, attribute, interaction, and interaction parameter names.

Realization

Naming conventions and a constrained set of names are a worthy goal. Unless tools are provided which utilize these content standards in the creation of FOMs and SOMs, it is doubtful benefits will be realized. Utilization of the content standards will be achieved by the creation of an HLA-DD to contain established content standards and associated tools to allow the reuse of those standards and the creation of new standards. The HLA-DD will be integrated with the federate and federation development tools including OMDTs developed by AEgis Corporation and The Analytic Services Corporation (TASC) as well as the HLA OML developed by the Joint Data Base Elements for Modeling and Simulation activity of the U.S. Army Electronic Proving Ground. The OMDTs will be able to access the contents of the HLA-DD, thus allowing federate and federation developer to pick and choose from existing established standards. Capabilities will also be provided to allow users to propose new FOM/SOM content standards. The links between the HLA-DD and the HLA OML will map the usage of content standards in FOMs and SOMs which have been stored in the HLA OML.

Repeatability

The true test of any content standard is its ability to make a process repeatable. Use of existing FOM/SOM content standards and creation of new content standards will become an integral part of the Federation Execution Development Process (FEDEP). If implementation of the content standards is successful, two different federate/federation developers describing the same simulation interfaces and using the content standards as part of the FEDEP, will produce identical FOMs or SOMs.

Reuse

One of the biggest benefits from establishing a set of content standards is reusability. HLA FOM/SOM content standards, along with components from the HLA OML, will allow federate and federation developers to create FOMs and SOMs expeditiously. With immediate access to reusable content standards and components, developers will not have to decide on what terms and representations to define when usable ones have already been established. Effective reuse will be based on integration of the HLA OML and the content standards with the OMDTs as FEDEP infrastructure components.

PROGRAM SUPPORT

The HLA FOM/SOM Content Standards Program will follow the same approach as other DMSO-sponsored initiatives by starting with a small focused set of demonstrations and later expanding to support additional programs.

During the initial phase of the HLA FOM/SOM Content Standards Program, three simulation initiatives are being supported. The focus is on early adopters of HLA standards which include the development of the following FOMs:

Real-time Platform-Level Reference (RPR) FOM

This FOM is being developed to expedite the transition to the HLA of existing simulations which are based on the IEEE 1278.1 protocol standards. This FOM has been designated in the past by the real-time platform-level simulation community as the "Plug and Play FOM" and the "1278.1 Reference FOM."

Command and Control Integrated Program Team (C2 IPT) FOM

The C2 IPT FOM is based on the integration of Joint Simulation System (JSIMS) Testbed component simulations with the operational C4I systems through the Modular Reconfigurable C4I Interface (MRCI). To a large extent, development of this FOM will involve the integration of the prior Joint Task Force Protofederation FOM with existing MRCI FOM components.

Test and Evaluation (T&E) Applications FOM

The T&E Applications FOM will address engineering-level simulations. This FOM represents extensions to the prior Engineering Protofederation FOM.

By addressing such a broad range of initiatives, the HLA FOM/SOM Content Standard Program will be able to address many key issues. Among those issues is whether a single set of standards can support a diverse set of applications ranging from the engineering level through the operational level. Alternatively, this effort may show that multiple sets of interrelated standards are required to support multiple levels of simulation fidelity.

EXISTING STANDARDS SOURCES

Rather than relying on creating new content standards, the HLA FOM/SOM Content Standards Program will examine several existing standards sources for potential applicability to FOM and SOM creation. During the initial phase of this program, the following existing standards sources will be evaluated:

DoD Data Dictionary System (DDDS)

The DDDS contains approved and candidate prime words and data elements as well as those under development. Prime words generally correspond to class names in FOMs and data elements generally correspond to either class attribute names or interaction parameter names. The DDDS also contains domains for some data elements which will generally correspond to enumerations for class attributes or interaction parameters. Preliminary analysis has shown that concepts in the DDDS and existing FOMs and SOMs are

sometimes represented at different levels of abstraction. For this reason, a prime word in the DDDS may correspond to a class attribute name in a FOM. Other mapping combinations are possible.

DoD Data Model (DDM)

The DDM is a collection of entity-relationship diagrams which provide the basis for the contents in the DDDS. In addition to providing the prime words and data elements (which generally correspond to FOM/SOM classes and attributes/interaction parameters respectively), the DDM also specifies names for relationships between prime words which can potentially be used as interaction names. The entity-relationship language used for the DDM also supports the concept of categorization of prime words which can potentially provide guidelines for class hierarchies in FOMs and SOMs.

Universal Joint Task List (UJTL)

The UJTL presents a process view of military operations. Processes in the UJTL will be potential sources of interaction names in FOMs and SOMs.

Conceptual Models of the Mission Space (CMMS) Verb Dictionary

As the name implies, the CMMS verb dictionary contains verbs commonly used in the description of military operations. These verbs have been traced to authoritative sources and have the potential to serve as interaction names in FOMs and SOMs.

PROGRAM ACTIVITIES

The HLA FOM/SOM Content Standards Program covers a range of activities from analysis to the development and integration of tool sets.

Data Interchange Formats (DIFs) and Library Development

Key to the success of the HLA program is the ability to store and interchange information about HLA federations and federates. Each of following activities provides a portion of that critical interchange and storage:

Object Model Template Data Interchange Format (OMT DIF)

The OMT DIF provides an unambiguous way to exchange OMTs used to describe FOM and SOM interfaces. The OMT DIF is an ASCII text structure rigorously defined in Bacus Naur Form (BNF). It is supported by the alpha versions of the OMDTs as well as the HLA OML. The OMT DIF currently stands at revision 1.0-8, but has not yet been publicly released. As the OMT evolves, the OMT DIF will be modified to support all OMT concepts, rules, and constructs.

HLA Object Model Library (OML)

The HLA OML is a Hypertext Markup Language (HTML)-based application which allows users to store, retrieve, query, and browse FOMs and SOMs stored in its underlying database. It is anticipated the HLA OML will be the central repository of reusable FOMs and SOMs for federate and federation developers. The alpha version of this software has been demonstrated to the HLA Architecture Management Group, but is has not yet been released for public use.

FED Data Interchange Format (FED DIF)

The FED DIF will provide an independent method to exchange HLA Interface Specification (IF_Spec)-specific Run Time Interface (RTI) initialization data as well as other setup information (such as data distribution management services instructions). The FED DIF will not be specific to any one RTI implementation, but rather will be supported by all RTIs which are built in accordance with the IF_Spec.

"Quick Start" Content Analysis

As a first step, the HLA FOM/SOM Content Standards Program performed a "quick start" analysis to determine the feasibility of applying existing external standards to the content of FOMs and SOMs. Data elements from the DDDS were used as the external standards. These were compared with: 1) the Distributed Interactive Simulation (DIS) PDU elements and enumerations, and 2) the class attributes from the MRCI FOM used to specify the interface with the U.S. Air Force Contingency Tactical Air Planning System (CTAPS). Although the DIS PDUs are not represented as a FOM, it was recognized that the PDU elements and enumerations would be utilized in the construction of what is now the RPR FOM. Results of this analysis are presented in Table 1.

Comparison	DIS PDU	MRCI/CTAPS
Equivalent	37%	49%
Similar	28%	41%
No Match	35%	10%

Table 1. Quick Start Analysis Results

The contents of this table show how data elements from the DDDS relate to the contents of the DIS PDUs and the MRCI/CTAPS FOM. For example, 49 percent of the attributes from the MRCI/CTAPS FOM have equivalent data elements in the DDDS. These encouraging results suggest that, in the large majority of cases, external standards have already been created which are either equivalent or similar to FOM or SOM content.

Common Semantics and Syntax Development

The core of the HLA FOM/SOM Content Standards task will be developing a set of common semantics and syntax (CSS) for use in FOM and SOM construction. In the initial phase of this project, the CSS will be based on the contents of the HLA early adopters previously identified in this paper. The HLA FOM/SOM Content Standards Program Team will work closely with the developers of these FOMs to develop a set of representations for classes, class attributes, interactions, and interaction parameters based on requirements for the FOMs and utilizing the previously identified existing standards where possible. Where existing standards are not suitable, new standards or changes to existing standards will be proposed. Where possible, CSS will be defined to support multiple early adopter FOMs. Furthermore, where multiple representations are necessary to support the differing levels of fidelity, they will be developed.

HLA-DD Implementation

As stated earlier, one of the products of the FOM/SOM Content Standards Program will be the development of an HLA-DD. In addition to containing the FOM/SOM content standards, the HLA-DD will provide tools to: 1) map external standards to the contents of the HLA-DD, and 2) map the contents of the HLA-DD to the contents of existing FOMs and SOMs. Existing tools, such as the Data Analysis and Reconciliation Tool (DART), are being evaluated for adaptation and extension to serve this purpose. DMSO plans to propose extensions to the DDDS to support additional HLA OMT constructs (such as interactions). Early stages of the HLA-DD implementation are currently underway and include defining the complete set of metadata needed for the HLA-DD and the functional requirements for search and browse capabilities. The target for initial implementation of the HLA-DD is May 1997.

FOM/SOM Tool Integration

After the initial HLA-DD is developed, integration with existing OMDTs and the HLA OML will begin. The goal will be a seamless integration of the HLA-DD with the OMDTs, to allow OMDT users to utilize FOM/SOM content standards contained in the HLA-DD and propose new content standards during the creation

of a FOM or SOM. The integration with the HLA OML will allow the mapping of HLA-DD content standards to their usage in FOMs and SOMs stored in the HLA OML.

CONCLUSIONS

The establishment of HLA FOM/SOM content standards and the development of tools to create and utilize these content standards are critical to the success of the HLA. With the content standards and associated tools, the job of the federate and federation developer will be much easier. Developers using these standards and tools will be able to recognize reusable components allowing them to develop FOMs and SOMs in an expeditious and repeatable manner.

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